Fourth Quarter 2018: “David” Hotels Continue to Dominate the “Goliaths”

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Fourth Quarter 2018: “David” Hotels Continue to Dominate the “Goliaths”

Abstract
Hotels in gateway cities continue to shine, with prices rising 25 percent year over year, compared to an 8-percent rise for hotels in non-gateway cities. Hotel financial performance is still breakeven, with operating profit similar to a hotel property’s borrowing cost, based on economic value analysis. Year over year, mortgage financing volume for hotels fell, as interest rates on Class A and Class B and C hotel deals have risen. A reading of our tea leaves suggests prices are expected to decline for the “Goliaths,” that is, large hotels, while prices moderate (at best) or decline slightly (at worst) for smaller “David” hotels. This is report number 29 of the index series.

Supplemental File: Hotel Valuation Model (HOTVAL)
We provide this user friendly hotel valuation model in an excel spreadsheet entitled HOTVAL Toolkit as a complement to this report which is available for download from http://scholarship.sha.cornell.edu/creftools/1/

Keywords
Cornell Hotel Indices, economic value analysis (EVA), hotel prices, hedonic hotel index, gateway cities

Disciplines
Real Estate

Comments
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Hotels in gateway cities continue to shine, with prices rising 25 percent year over year, compared to an 8-percent rise for hotels in non-gateway cities. Hotel financial performance is still breakeven, with operating profit similar to a hotel property’s borrowing cost, based on economic value analysis. Year over year, mortgage financing volume for hotels fell, as interest rates on Class A and Class B and C hotel deals have risen. A reading of our tea leaves suggests prices are expected to decline for the “Goliaths,” that is, large hotels, while prices moderate (at best) or decline slightly (at worst) for smaller “David” hotels. This is report number 29 of the index series.
ABOUT THE AUTHORS


Adam D. Nowak is an associate professor of economics at West Virginia University. He earned degrees in mathematics and economics at Indiana University–Bloomington in 2006 and a degree in near-East languages and cultures that same year. He received a Ph.D. from Arizona State University. Nowak taught an introduction to macroeconomics course and a survey of international economics at Arizona State. He was the research analyst in charge of constructing residential and commercial real estate indices for the Center for Real Estate Theory and Practice at Arizona State University. Nowak’s research has been published in the Journal of Urban Economics, Regional Science and Urban Economics, Journal of Applied Econometrics, Real Estate Economics, and the Journal of Real Estate Research.

Robert M. White, Jr., CRE, is the founder and president of Real Capital Analytics Inc., an international research firm that publishes the Capital Trends Monthly. Real Capital Analytics provides real time data concerning the capital markets for commercial real estate and the values of commercial properties. Mr. White is a noted authority on the real estate capital markets with credits in the Wall Street Journal, Barron’s, The Economist, Forbes, New York Times, and Financial Times, among others. He is the 2014 recipient of the James D. Landauer/John R. White Award given by The Counselors of Real Estate. In addition, he was named one of National Real Estate Investor magazine’s “Ten to Watch” in 2005, Institutional Investor’s “20 Rising Stars of Real Estate” in 2006, and Real Estate Forum’s “10 CEOs to Watch” in 2007. Previously, Mr. White spent 14 years in the real estate investment banking and brokerage industry and has orchestrated billions of commercial sales, acquisitions, and recapitalizations. He was formerly a managing director and principal of Granite Partners LLC and spent nine years with Eastdil Realty in New York and London. Mr. White is a Counselor of Real Estate, a Fellow of the Royal Institution of Chartered Surveyors, and a Fellow of the Homer Hoyt Institute. He serves on the board of directors for the Pension Real Estate Association and the advisory board for the Real Estate Research Institute. He is also a member of numerous industry organizations and a supporter of academic studies. Mr. White is a graduate of the McIntire School of Commerce at the University of Virginia. His research has been published in the Journal of Real Estate Finance and Economics.

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Disclaimer
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Cornell Hotel Indices: Fourth Quarter 2018:

“David” Hotels Continue to Dominate the “Goliaths”

Crocker H. Liu, Adam D. Nowak, and Robert M. White, Jr.

Analysis of Indices through Q4, 2018

Gateway Cities Continue to Outshine Non-Gateway Cities. Hotels in gateway cities continue to outperform properties in non-gateway cities, as shown in Exhibit 1. The price of hotels in gateway cities rose 25 percent year over year (and 7.5 percent quarter over quarter) in this period, compared to 16 percent year over year (and .5 percent quarter over quarter) in the previous period. In contrast, hotel prices in non-gateway cities rose 8 percent year over year (6 percent quarter over quarter), compared to 2.3 percent year over year (1.5 percent quarter over quarter) in the prior period.

Exhibit 1

Hotel performance for gateway cities versus non-gateway cities

Sources: Cornell Center for Real Estate and Finance, CoStar, Real Capital Analytics
Hotel Investment Based on Operating Performance Is Still in the Black (Breakeven). Our economic value added (EVA) indicator shown in Exhibit 2 has continued to remain positive at .001 (same value as in the previous quarter). For all practical purposes, the EVA indicator has continued to hover around zero since the second quarter of 2016. Although the cost of debt financing declined to 5.63 percent in 2018Q3 (from 6.66 percent in 2018Q2), the ACLI hotel cap rate has also fallen, from 7.5 percent (2018Q2) to 7 percent (2018Q3). Thus, as suggested in Exhibit 3, positive leverage continued to be the norm for hotel deals in 2018Q3 (the latest quarter for which ACLI data exists). This means that penciling feasible deals was easier to achieve as a result of a widening of the spread between the cap rate and the cost of debt financing. Intuitively, the investor should receive a higher return than his or her borrowing cost.

The Median Price of Hotels Rose on a Quarterly as well as a Year-over-Year Basis. The median price of hotels rose approximately 26 percent from the previous quarter ($6.445M versus $5.125M). However, the total volume of all hotel transactions (both large hotels and small hotels combined) fell 16.2 percent (280 transactions this period as compared to 334 transactions previously), as reported in Exhibit 4 (including Exhibits 4a, 4b, and 4c).
Exhibit 3

Return on investment capital versus cost of debt financing

Sources: ACLI, Cornell Center for Real Estate and Finance

About the Cornell Hotel Indices

In our inaugural issue of the Cornell Hotel Index series, we introduced three new quarterly metrics to monitor real estate activity in the hotel market. These are a large hotel index (hotel transactions of $10 million or more), a small hotel index (hotels under $10 million), and a repeat sales index (RSI) that tracks actual hotel transactions. These indices are constructed using the CoStar and RCA commercial real estate databases. The large and small hotel indices are similar in nature and construction to the consumer price index (CPI), while the repeat sale hotel index is analogous to the retail concept of same store sales. Using a similar logic process for hotels, we compare the sales and resales of the same hotel over time for that index. All three measures provide a more accurate representation of the current hotel real estate market conditions than does reporting the average transaction prices, because the average-price index doesn’t account for differences in the quality of the hotels, which also is averaged. A more detailed description of these indices is found in the first edition of this series, “Cornell Real Estate Market Indices,” which is available at no charge from the Cornell Center for Real Estate and Finance. Starting with our 2018Q1 issue, we introduced the Gateway Cities Index as a new metric in our hotel analytics arsenal. Cities that we define as gateway cities are Boston, Chicago, Honolulu, Los Angeles, Miami, New York, San Francisco, and Washington, D.C. In this issue, we present updates and revisions to our hotel indices along with commentary and supporting evidence from the real estate market.

1 For a general discussion on what constitutes a gateway city, see: Corgel, J.B. (2012), What Is a Gateway City?: A Hotel Market Perspective, Center for Real Estate and Finance Reports, Cornell University School of Hotel Administration. The study of Corgel, J. B., Liu, C., & White, R. M. (2015). Determinants of hotel property prices. Journal of Real Estate Finance and Economics, 51, 415-439 finds that a significant driver of hotel property prices is whether a hotel is located in a gateway city. The presumption is that hotels (and other real estate) in gateway cities exceed other cities as IRR generators in part due to a generally stronger economic climate as a result of higher barriers to entry, tighter supply, and/or relatively stronger performance in terms of revenue per available room than other top cities that are not gateways.
Transaction volume (obs) and median sale price (part 1: 1995–2004)

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### Exhibit 4b

Transaction volume (obs) and median sale price (part 2: 2005–2014)

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<td>4500000</td>
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Year over year (2017Q4 versus 2018Q4), the median price of hotels rose 43.2 percent, while the volume of hotel transactions also increased, by 5.7 percent. A comparison of large hotels relative to smaller hotels on a year-over-year basis reveals that the median price of large hotels fell 26.8 percent on stronger volume (+59%), while in contrast the median price of small hotels rose 14.8 percent on weaker volume (-12%). By comparison, the price change for hotels sold in gateway cities increased 18 percent on stronger volume (+27%). A similar situation exists on a quarter-over-quarter basis for large hotels, with the median sale price of large hotels falling 3.6 percent on stronger transaction volume (+27%). The median sale price of smaller hotels also declined by 11 percent, albeit on weaker volume (-30%). The only bright spot was found in hotels in gateway cities, which rose in price (+8%) on stronger transaction volume (+50%).

Exhibit 5 and Exhibit 6 show this year-over-year trend in the number of transactions for large hotels and small hotels.

1 Note that the number of transactions is limited to the sales that are included in the hedonic index. As such, it should not be construed as being the total market activity.
**Exhibit 5**

Median sale price and number of sales for high-price (large) hotels (sale prices of $10 million or more)

**Exhibit 6**

Median sale price and number of sales for low-price (small) hotels (sale prices of less than $10 million)

*Sources: CoStar, Real Capital Analytics*
Exhibit 7

Hotel indices through 2018, quarter 4

<table>
<thead>
<tr>
<th>YrQtr</th>
<th>Low Priced Hotels (&lt;$10M)</th>
<th>High Priced Hotels (=&gt;$10M)</th>
<th>Non Gateway Index</th>
<th>Gateway Index</th>
<th>Repeat Sales Index</th>
<th>RSI</th>
<th>Index Value</th>
<th>Repeat Sales</th>
</tr>
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<tr>
<td>1995</td>
<td>98.085629</td>
<td>93.692038</td>
<td>82.7046</td>
<td>101.984</td>
<td>63.249055</td>
<td>NA</td>
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<td>1996</td>
<td>100.62077</td>
<td>67.300377</td>
<td>85.5188</td>
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<td>1997</td>
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<td>89.155805</td>
<td>89.9698</td>
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<td>70.326626</td>
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<td>1998</td>
<td>95.037914</td>
<td>93.097592</td>
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<td>74.525727</td>
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<td>1999</td>
<td>100.05399</td>
<td>97.475029</td>
<td>104.973</td>
<td>90.6081</td>
<td>73.660911</td>
<td>NA</td>
<td>10.0471</td>
<td>228.5836</td>
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<td>2000</td>
<td>94.862583</td>
<td>105.76096</td>
<td>105.274</td>
<td>103.433</td>
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<td>2001</td>
<td>104.31046</td>
<td>96.75269</td>
<td>112.822</td>
<td>109.588</td>
<td>87.235365</td>
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<td>2002</td>
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<td>91.500411</td>
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<td>2003</td>
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<td>105.931</td>
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<td>95.357898</td>
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<td>2004</td>
<td>104.4311</td>
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<td>102.09167</td>
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<td>2005</td>
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<td>98.897352</td>
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<td>2006</td>
<td>112.21806</td>
<td>123.88583</td>
<td>127.491</td>
<td>133.935</td>
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<td>2007</td>
<td>114.87326</td>
<td>121.22321</td>
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<td>106.22309</td>
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<td>2008</td>
<td>115.62107</td>
<td>130.6991</td>
<td>126.138</td>
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<td>107.30798</td>
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<td>569.4092</td>
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<td>2009</td>
<td>111.08729</td>
<td>122.73253</td>
<td>114.604</td>
<td>117.514</td>
<td>97.023891</td>
<td>NA</td>
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<td>640.7913</td>
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<tr>
<td>2011</td>
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<td>111.25404</td>
<td>94.8814</td>
<td>105.089</td>
<td>90.09194</td>
<td>NA</td>
<td>10.0471</td>
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<tr>
<td>2012</td>
<td>101.72764</td>
<td>99.564611</td>
<td>93.8646</td>
<td>100.054</td>
<td>91.105856</td>
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<td>2013</td>
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<td>96.3533</td>
<td>95.740376</td>
<td>97.774274</td>
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<td>2014</td>
<td>101.64411</td>
<td>102.85361</td>
<td>99.233</td>
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<td>98.538527</td>
<td>97.774274</td>
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<td>2015</td>
<td>100.61105</td>
<td>96.278961</td>
<td>101.666</td>
<td>96.056</td>
<td>90.031256</td>
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<td>2016</td>
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<td>101.24149</td>
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<td>101.88</td>
<td>98.382195</td>
<td>94.810985</td>
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<td>2017</td>
<td>106.07236</td>
<td>118.79999</td>
<td>109.693</td>
<td>105.659</td>
<td>97.607025</td>
<td>93.579772</td>
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<td>2018</td>
<td>110.00836</td>
<td>121.76073</td>
<td>110.319</td>
<td>117.681</td>
<td>97.8886</td>
<td>92.640503</td>
<td>10.0471</td>
<td>1219.2903</td>
</tr>
</tbody>
</table>
Exhibit 8, which graphs the prices reported in Exhibit 7, shows that the prices of large hotels continue their downward trend, falling 2 percent this quarter compared to a .4-percent decline last quarter. On the other hand, smaller hotels continued to post positive price performance, rising 2.9 percent this quarter compared to a 1.8-percent rise last quarter. In contrast, Exhibit 9...
shows that on a year-over-year basis, prices for large hotels inched up .86 percent (2017Q4-2018Q4), far less than the 5.5-percent jump recorded in the prior year-over-year period (2017Q3-2018Q3). Exhibit 10 shows that prices for smaller hotels rose 5.4 percent (2017Q4-2018Q4), a stronger performance than the 3.4-percent increase in the prior period (2017Q3-2018Q3). Thus, we conclude that the price of large hotels increased at a decreasing rate, while the price of small hotels increased at an increasing rate on a year-over-year basis.

Our moving average trend lines for large hotels (in Exhibit 11) show that the price for large hotels is now approaching its short-term moving average trend line, albeit remaining above its longer term moving average trend line. In contrast to this, Exhibit 12 shows that the price for smaller hotels not only continues...
EXHIBIT 10

Year-over-year change in small-hotel index, with moving-average trend line

Sources: Cornell Center for Real Estate and Finance, CoStar, Real Capital Analytics

EXHIBIT 11

Moving average trend line for large-hotel index

Sources: Cornell Center for Real Estate and Finance, CoStar, Real Capital Analytics
to exceed both its short-term and long-term moving average trend lines, but we also see that the spread between the price and these trend lines is widening. Based on our moving average indicators, positive momentum continues to persist for small properties but not large hotels this quarter. This indicates a continued signal that small hotels are still a buy and hold. Larger hotels however are moving towards a sell signal.

Our Standardized Unexpected Price (SUP) metrics in Exhibit 13 show that the price of large hotels continued its descent this quarter, in contrast to the statistically significant and positive price momentum of smaller hotels, as depicted in Exhibit 14 (observe that both metrics are above the upper significance band).

Repeat Sales: Prices Are Rising at a Decreasing Rate. Similar to small hotels, our repeat sale indicator
EXHIBIT 13

Standardized unexpected price (SUP) for high-price hotel index

Sources: Cornell Center for Real Estate and Finance, CoStar, Real Capital Analytics

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EXHIBIT 14

Standardized unexpected price (SUP) for small-hotel index

Sources: Cornell Center for Real Estate and Finance, CoStar, Real Capital Analytics
The price of hotels that have sold more than once (repeat sales) is still higher than either its short-term and long-term moving average. Our SUP performance metric (in Exhibit 16) indicates that although standardized prices continued to demonstrate positive strength this quarter, they still remain below the upper significance line, in contrast to the situation with small hotels (referring to Exhibit 14). Exhibit 17 shows that the repeat sale price index is increasing at a decreasing rate, as follows. The repeat sale price index rose 3 percent year over year (2017Q4 to 2018Q4), down from a 4.6-percent price rise year over year (2017Q3 to 2018Q3) in the previous period. It also increased about 1 percent quarter over quarter (2018Q3-2018Q4), a smaller increase than the 2.6 percent rise recorded in the previous quarter (2018Q2-2018Q3).

Mortgage Financing Volume for Hotels Declined Year over Year and Also Quarter over Quarter. Ex-

---

**Exhibit 15**

Moving average trend line for repeat sale-hotel index

![Graph showing moving average trend line for repeat sale-hotel index](image)

Sources: Cornell Center for Real Estate and Finance, CoStar, Real Capital Analytics

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2 We report two repeat sale indices. The repeat sale full sample index uses all repeat sale pairs, whereas the repeat sale index with a base of 100 at 2000Q1 uses only those sales that occurred on or after the first quarter of 2000, but not those before that time. As such, if a hotel sold in 1995 and then sold again in 2012, it would be included in the full sample, index but it would not be included in the repeat sale index that includes data from 2000 onward.
Exhibit 16

Standardized Unexpected Price (SUP) for hotel repeat sale index (full sample)

Sources: Cornell Center for Real Estate and Finance, CoStar, Real Capital Analytics

Exhibit 17

Year-over-year change in repeat-sale index, with moving-average trend line

Sources: Cornell Center for Real Estate and Finance, CoStar, Real Capital Analytics
The biggest advantage of year-over-year comparisons relative to quarter-over-quarter comparisons is that they mitigate the effect of seasonality in addition to smoothing out any volatility in quarter-over-quarter numbers. It’s a good idea to look at quarter-to-quarter as well to get the full picture.
Exhibit 19

Interest rates on Class A hotels versus Class B and C properties

Source: Cushman Wakefield Sonnenblick Goldman

Exhibit 20

Interest-rate spreads of hotels versus U.S. Treasury ten-year bonds

Source: Cushman Wakefield Sonnenblick Goldman
2.20%; Class B spread: 2.65% versus 2.40%). The rise in interest rate spreads signals that lenders view hotels as relatively more risky relative to our last report, and as such lenders’ compensation for risk associated with hotel loans has increased. Exhibit 21 shows the spread between the interest rate on Class A full-service hotels (and B and C properties) over the interest rate corresponding to non-hotel commercial real estate. This spread represents the hotel real estate premium. The monthly hotel real estate premiums for both higher quality (Class A) and lower quality (Class B and C) hotels have remained constant relative to the prior quarter. In the current quarter (2018Q4), the hotel real estate premium averaged .43 percent (.53% for B and C hotels), exactly the same as the premiums in the previous quarter (2018Q3). This is a signal that the perceived default risk for hotel properties relative to other commercial real estate (office, retail, industrial, and apartments) has remained the same this quarter compared to the previous quarter.

Cost of Equity Financing Remained Relatively Constant, although the Riskiness of Hotels Relative to Other Types of Commercial Real Estate Has Risen. The cost of using equity financing for hotels as measured using the Capital Asset Pricing Model (CAPM) on hotel REIT returns, as shown in Exhibit 22, increased imperceptibly this quarter. We found that the cost of using equity funds was 8.26 percent for 2018Q4, compared to 8.23 percent in the previous quarter. The cost of borrowing equity capital has thus remained relatively stable. In terms of total risk (systematic risk + risk that is unique to hotel REITs), Exhibit 23 shows that the total risk of hotel REITs rose this past quarter relative to the total risk of equity REITs as a whole. This is at odds with Exhibit 21, which shows that the perceived default risk for hotels has remained constant (stable) relative to other types of commercial real es-

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6 The interest rate on hotel properties is generally higher than that for apartment, industrial, office, and retail properties in part because hotels’ cash flow is commonly more volatile than that of other commercial properties.

7 We calculate the total risk for hotel REITs using a twelve-month rolling window of monthly return on hotel REITs.
Exhibit 22

Cost of equity financing using the Capital Asset Pricing Model and hotel REITs

Sources: Cornell Center for Real Estate and Finance, NAREIT

Exhibit 23

Risk differential between hotel REITs and equity REITs

Sources: Cornell Center for Real Estate and Finance, NAREIT
tate, as we noted above. Expect higher borrowing costs for hotel loans to ensue given these metrics.

Expect the Prices of Large Hotels and Small Hotels to Fall, Based on Our Reading of the Tea Leaves. Exhibit 24 compares the performance of the repeat sales index relative to the NAREIT Lodging/Resort Price Index. Note that the repeat sales index tends to lag the NAREIT index by at least one quarter or more. Looking ahead, the NAREIT lodging index declined almost 22 percent this quarter compared to no change in the prior quarter, while it also decreased 17.5 percent year over year. We see then that the moving average NAREIT Lodging/Resort trendline has started to edge down, signaling a negative price momentum.

The architecture billings index (ABI) for commercial and industrial property, which represents another forward-looking metric, declined this quarter from the previous quarter, as shown in Exhibit 25 (48.9 versus 50.8). The ABI metric provides confirmatory evidence that we should expect decreasing price momentum. The National Association of Purchasing Managers (NAPM) index shown in Exhibit 26, which is an indicator of anticipated business confidence and thus business traveler demand, decreased 9.4 percent year over year (-9.5 percent on a quarter-over-quarter basis) compared to a 2-percent increase in the prior year-over-year period (2017Q3-2018Q3). Based on the moving average trendline for NAPM index, we expect

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8 This is consistent with prior academic studies which find that securitized real estate is leading indicator of underlying real estate performance, since the stock market is forward looking or efficient.

9 As of the time of this writing, only the October 2018 AIA Billings Index has been reported. The December index was scheduled for release on January 23, 2019. See: www.aia.org/practicing/economics/aias076265.

10 The ISM: Purchasing Managers’ Index, (Diffusion index, SA), also known as the National Association of Purchasing Managers (NAPM) index, is based on a survey of over 250 companies within twenty-one industries covering all 50 states. It not only measures the health of the manufacturing sector but is a proxy for the overall economy. It is calculated by surveying purchasing managers for data about new orders, production, employment, deliveries, and inventory, in descending order of importance. A reading over 50% indicates that manufacturing is growing, while a reading below 50% means it is shrinking.
**Exhibit 25**

Hotel repeat sales index versus architecture billings index

- **Sources:** Cornell Center for Real Estate and Finance, American Institute of Architects

**Exhibit 26**

Business confidence index (National Association of Purchasing Managers) and high-price hotel index

- **Sources:** Cornell Center for Real Estate and Finance, Institute for Supply Management (ISM)
the price of large hotels to fall over the next quarter. The Consumer Confidence Index from the Conference Board, graphed in Exhibit 27, which we use as a proxy for anticipated consumer demand for leisure travel and a leading indicator of the hedonic index for low priced hotels, rose 5 percent year over year (9.5 percent quarter over quarter) continuing its positive trend from the previous period (15.5%), although the rate of increase has declined. We expect the price momentum for small hotels to moderate at best and decline at worst in the next quarter.

**Hotel Valuation Model (HOTVAL) Has Been Updated.** We have updated our hotel valuation regression model to include the transaction data used to generate this report. We provide this user-friendly hotel valuation model in an Excel spreadsheet entitled HOTVAL Toolkit as a complement to this report. The tool is available for download from our CREF website.
Appendix

SUP: The Standardized Unexpected Price Metric

The standardized unexpected price metric (SUP) is similar to the standardized unexpected earnings (SUE) indicator used to determine whether earnings surprises are statistically significant. An earnings surprise occurs when the firm’s reported earnings per share deviates from the street estimate or the analysts’ consensus forecast. To determine whether an earnings surprise is statistically significant, analysts use the following formula:

$$SUE_Q = \frac{(A_Q - m_Q)}{s_Q}$$

where $SUE_Q$ = quarter Q standardized unexpected earnings, $A_Q$ = quarter Q actual earnings per share reported by the firm, $m_Q$ = quarter Q consensus earnings per share forecasted by analysts in quarter Q-1, and $s_Q$ = quarter Q standard deviation of earnings estimates.

From statistics, the $SUE_Q$ is normally distributed with a mean of zero and a standard deviation of one (~N(0,1)). This calculation shows an earnings surprise when earnings are statistically significant, when $SUE_Q$ exceeds either $\pm 1.645$ (90% significant) or $\pm 1.96$ (95% significant). The earnings surprise is positive when $SUE_Q > 1.645$, which is statistically significant at the 90% level assuming a two-tailed distribution. Similarly, if $SUE_Q < -1.645$ then earnings are negative, which is statistically significant at the 90% level. Intuitively, SUE measures the earnings surprise in terms of the number of standard deviations above or below the consensus earnings estimate.

From our perspective, using this measure complements our visual analysis of the movement of hotel prices relative to their three-year and five-year moving average ($\mu$). What is missing in the visual analysis is whether prices diverge significantly from the moving average in statistical terms. In other words, we wish to determine whether the current price diverges at least one standard deviation from $\mu$, the historical average price. The question we wish to answer is whether price is reverting to (or diverging from) the historical mean. More specifically, the question is whether this is price mean reverting.

To implement this model in our current context, we use the three- or five-year moving average as our measure of $\mu$ and the rolling three- or five-year standard deviation as our measure of $\sigma$. Following is an example of how to calculate the SUP metric using high price hotels with regard to their three-year moving average. To calculate the three-year moving average from quarterly data we sum 12 quarters of data then divide by 12:

$$\text{Average} (\mu) = \frac{(70.6+63.11+58.11+90.54+95.24+99.70 +108.38+99.66+101.62+105.34+109.53+115.78)}{12} = 93.13$$

$$\text{Standard Deviation} (\sigma) = 18.99$$

$$\text{Standardized Unexp Price (SUP)} = \frac{(115.78-93.13)}{18.99} = 1.19$$
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